

Wright State University

## CORE Scholar

---

Master of Public Health Program Student  
Publications

Master of Public Health Program

---

2012

### Analysis of an Improved Cook Stove Intervention in Rural Guatemala

Chad Graven

*Wright State University - Main Campus*

Follow this and additional works at: <https://corescholar.libraries.wright.edu/mph>



Part of the [Community Health and Preventive Medicine Commons](#)

---

#### Repository Citation

Graven, C. (2012). *Analysis of an Improved Cook Stove Intervention in Rural Guatemala*. Wright State University, Dayton, Ohio.

This Master's Culminating Experience is brought to you for free and open access by the Master of Public Health Program at CORE Scholar. It has been accepted for inclusion in Master of Public Health Program Student Publications by an authorized administrator of CORE Scholar. For more information, please contact [library-corescholar@wright.edu](mailto:library-corescholar@wright.edu).

Analysis of an Improved Cook Stove Intervention in Rural Guatemala

Chad Garven

Wright State University

### **Acknowledgements**

I gratefully acknowledge Dr Dan Palazuelos, Lindsay Palazuelos, Dr. Cristina Redko, the staff and volunteers of ETESC, and the wonderful community members of Jacaltenango, San Marcos, Xayolomaj, Lupina, and Laguna who collaborated together and made this research possible.

**Table of Contents**

Abstract .....	4
Introduction.....	5
Statement of Purpose .....	6
Literature Review.....	6
Methods.....	17
Results .....	21
Discussion .....	39
References .....	44
Appendices.....	49

### Abstract

An estimated three billion people cook and heat their homes using open fires and nearly two million people die prematurely from illness attributable to indoor air pollution from solid fuel use. According to the World Health Organization, “every year, indoor air pollution is responsible for the death of 1.6 million people...one death every twenty seconds.” Various international groups, government initiatives, and communities have attempted to improve this indoor air pollution problem around the world by implementing various improved cook stove models. In July, 2011, Partners In Health (PIH) and Equipo Técnico de Educación en Salud Comunitaria (ETESC) co-directed the delivery of ONIL stoves to 175 homes in the communities in and around Jacaltenango, Guatemala, a rural area in the Western Highlands of the country. In October, 2011, a team of PIH and ETESC’s community health workers and researchers performed a modified Rapid Assessment and Evaluation (RARE) analysis of the use of the stoves and the broader cultural significance of the project. One hundred and eighteen randomly selected homes of the 175 receiving the stove intervention were interviewed before and after the stove’s installation. Through multiple interviews various perceptions were gleaned regarding the stoves. These perceptions included positive benefits regarding health, social interactions, home environment, dignity, and safety. These were contrasted with negative impacts such as installation barriers, size constraints, seasonal barriers, and isolation. Along with a quantitative assessment, this report identifies areas for further research, particularly for a more thorough ethnographic assessment of a cook stove intervention program.

### **Analysis of an Improved Cook Stove Intervention in Rural Guatemala**

Around three billion people cook and heat their homes using open fires and estimates are that nearly two million people die prematurely from illness attributable to indoor air pollution from solid fuel use (WHO, 2011). Indoor air pollution is a term that refers to the increased amount of smoke and other particulate matter in households that typically use traditional, three-stone cook stoves in the developing world. Cooking and heating with solid fuels (biomass) on these open fires and other traditional stoves results in higher levels of indoor air pollution.

The World Health Organization (WHO) (2011) estimates that this indoor smoke can exceed acceptable levels for small particles 100-fold. Almost half of the deaths of children under five years old from acute lower respiratory infections are caused by particulate matter inhaled due to this same solid fuel use (WHO, 2011). Many studies of indoor air pollution have shown that there are identifiable increases in rates of still births (Mavalankar, Trivedi, & Gray, 1991), risk of tuberculosis (Mishra, Retherford, & Smith, 1999), blood pressure (WHO, 2006), and prevalence of cataracts or blindness (Pokhrel, Smith, Khalakdina, Deuja, & Bates, 2005). Furthermore, biomass smoke has been established as an independent risk factor for development of chronic obstructive pulmonary disease (Orozco-Levi, Garcia-Aymerich, & Ramirez-Sarmiento, 2006) as well as potentially exacerbating the health effects of HIV infection (Fullerton, Bruce, & Gordon, 2008).

The need to address this problem has not gone unrecognized. Various international groups, government initiatives, and communities themselves have undertaken attempts to improve this indoor air pollution problem around the world. For example, China's National Improved Stove Program in the 1980s introduced 130 million improved cook stoves to rural areas of the country (Sinton et al., 2004). Since the 1980s, the United States-based non-profit HELPS International has utilized their ONIL stove to improve safety, ventilation, and efficiency

of the biomass stove model installing stoves in Guatemala and Mexico (Helps International, 2004). Recently, the United Nations Foundation, World Bank, and other parties joined to create the Global Alliance for Clean Cookstoves. This group has a goal to install clean and efficient cooking stoves and fuels in 100 million homes by 2020 (Global Alliance for Clean Cookstoves, 2012).

Along with a quantitative assessment, this document identifies areas for further research, particularly for a more thorough ethnographic assessment of a cook stove intervention program. This research intends to explore the social implications of an improved cook stove intervention in the rural Western Highlands area of Guatemala.

### **Statement of Purpose**

The purpose of this study is to better understand how the lives of those involved in the joint clean cook stove project have changed, through or because of the project enacted by Partners In Health (PIH) and Equipo Técnico de Educación en Salud Comunitaria (ETESC). The community changes for the rural residents of Jacaltenango, Guatemala, are assessed.

### **Literature Review**

#### **What is Biomass Fuel?**

The population throughout the developing world relies on cook stoves for its basic needs. There are numerous functions of these stoves besides preparing food, such as disinfecting water, lighting the kitchen, or heating the home. These stoves are often powered by biomass. In its most general sense biomass is any burned plant or animal material. Biomass takes various forms: wood, plants, charcoal, and dung. More than half of the world's population relies on biomass combustion in order to meet basic domestic energy needs—estimated to be nearly 2.5 billion

people burning nearly 730 million tons of biomass per year in various cook stoves (World Bank, 2011).

The Latin American country of Guatemala is no exception to this strong reliance on biomass cook stoves. Most recent estimates of the Guatemalan population are 14.7 million people (World Bank, 2011). Older estimates were that nearly 60% of the Guatemalan population used solid fuels, primarily wood, in their cook stoves (Agarwal, 1986). A similar study to that of the research contained in this document has found that areas of rural Guatemala have a high prevalence of cooking with traditional open, three-stone, wood fires (Diaz et al., 2008).



*Figure 1. Three-stone wood fire*

People obtain three stones of the same height and then balance a cooking pot on top of a roaring fire. When money allows, members of various communities will purchase a circular iron stand that sits just above the flames instead of using the three stones. These three-stone fires are the cheapest and simplest to produce when compared to other options for improved stoves. ‘Improved’ refers to any modifications to a stove whether that is enhanced ventilation, increased efficiency, or alternative fuel source.





*Figure 2.* Iron stand adaptation for biomass stove

Given the sheer number of people using these stoves, the influence of biomass cook stoves is felt on the health, economy, and environment of communities around the world.

### **Health Implications**

Commonly, homes in rural Guatemala are one-level, one or two room dirt floor shelters. Having a fire that is freely ventilated into these spaces has predictable implications for the ambient air. Typically referred to as indoor air pollution, this ambient smoke has also more recently been referred to as “household air pollution” (WHO, 2012). The amount of smoke and particulate matter given off by a traditional stove has shown that the burned biomass fuels give off a mixture of gases and suspended particles not limited to, but including carbon dioxide, water, vapor, oxides of nitrogen, and carbon monoxide (Zhang & Smith, 2002). More concerning, another study has identified gas-phase hydrocarbons including carcinogenic compounds such as benzene, 1,3-butadiene, and styrene that are released in significant amounts during biomass burning (Zhang & Smith, 1996).

The profound health impacts are wide-ranging. According to the WHO, “every year, indoor air pollution is responsible for the death of 1.6 million people...one death every twenty seconds” (WHO, 2011). Smith, Mehta, and Fuez performed a meta-analysis in 2004 that showed

that young children exposed to smoke from household biomass fuel had a rate of acute lower respiratory infection twice that of children not exposed to biomass. A study in Mexico over seven years looked at over 500 women exposed to burning biomass and described that women exposed to burnt biomass developed chronic obstructive pulmonary disease with clinical characteristics, quality of life, and increased mortality similar in degree to that of tobacco smokers (Ramirez-Venegas et al., 2006). As stated previously, others have also shown increased rates of still births (Mavalankar et al., 1991), risk of tuberculosis (Mishra et al., 1999), blood pressure (WHO, 2006), and prevalence of cataracts or blindness (Pokhrel et al., 2005). Additionally, biomass smoke has been established as an independent risk factor for development of COPD (Orozco-Levi et al., 2006) as well as potentially exacerbating the health effects of HIV infection (Fullerton et al., 2008).

Other symptoms such as cough, chronic cough greater than 3 months, phlegm, chronic phlegm greater than 3 months, wheeze, and tightness in the chest have been observed at high rates in Guatemala biomass cook stove users specifically when compared to those who do not use similar stoves (Diaz et al., 2007).

The open stove model is also noted to be very dangerous. These fires are often kept on the ground or very near to the ground. This opens the possibilities for scalds and burns of not only those using the stove, but also the children that are typically close to and on the same level as the fire (Harris, Weeks, Chen, & Layde, 2011).

### **Economic Burden**

As stated above, the traditional three-stone cook stove model is chosen often because it is the cheapest option. The suggestion made here and elsewhere, however, is that the burden of cook stoves is often felt on the economically disadvantaged. The rural poor of Guatemala are

mainly dependent on the increasingly stressed sources of wood fuel because of both its abundance on the rural landscape and relative low cost (Helps International, 2004). This is in contrast to larger, more developed urban areas where the use of fuel wood for cooking has gradually reduced as utilization of liquefied petroleum gas or other more modern fuel options has increased.

Other research has begun to explore indoor air pollution's economic consequences. Duflo, Greenstone, and Hanna (2008) explored the theory of indoor air pollution and its relationship to the 'poverty trap.' The poverty trap has been described elsewhere (Dasgupta & Ray, 1986, 1987, 1990) and theorizes that because members of a family household are financially burdened and in poor health—poor health to a great degree attributed to local air pollution—and therefore unable to maintain consistent work, that the household continually remains in poor health and financially dire. These authors admit limited proof, but there is an obvious potential for the indoor air pollution to affect health as well as the overall economic well being of the home.

### **Environmental Impact**

The reliance on biomass, specifically wood, in cook stoves in Guatemala has had drastic impacts on the local forests and ecosystems in the form of deforestation and erosion. Current estimates for Guatemala are that the inefficient burning of wood contributes to national deforestation at a level of 2% per year (Helps International, 2004).

The traditional stove burns openly to the environment around it. This is incredibly inefficient for burning wood and other material because the heat is released to the air and not directed to items being cooked. In order to keep up with the dissipated heat, more wood is used

to perform tasks during the day. In turn, this leads to an increased need to gather more wood and thus causing more deforestation.

**What has been done?**

Initially, trying to replace the fuels was attempted as a solution; however, it was shown to be unsustainable long-term because of the cost of both the fuel and the set up of new devices using fuels such as liquid petroleum (International Energy Agency, 2006). The more common approach has been to implement a type of improved cooking stove in exchange for the traditional three-stone, ground, open-fire method. The improved stoves have been designed to burn fuel more efficiently and have typically incorporated a chimney or flue for ventilation. A study in rural Mexico of a subset of 4,000 improved cook stoves showed that stoves with chimneys and optimized combustion chambers can reduce indoor particulate matter and carbon monoxide by 66% and 67% respectively (Masera et al., 2007). A study of 79 homes in rural Honduras using improved stoves demonstrated a reduction of 63% of measured personal particulate matter, 73% lower levels of indoor particulate matter, and 87% lower levels of indoor carbon monoxide levels compared to traditional stoves in use in the same areas (Clark et al., 2009). With respect to health, a nonrandomized field trial of an intervention introducing improved stoves that were compared to the traditional, three-stone fireplace in a community in Kenya reported a relative risk increase of 2.8 (CI, 1.9-4.0) for acute respiratory infection associated with using the traditional stove (Wafula, Kinyaniui, Nyabola, & Tenambergen, 2000).

Most famously, Smith et al. (2011) performed the Randomized Exposure Study of Pollution Indoors and Respiratory Effects (RESPIRE) trial using a randomized controlled design to assess the impact of indoor air pollution reduction through an improved woodstove on lung health in a poor, rural population of Guatemala from 2002-2004. Five hundred and thirty-four

households with a pregnant woman or a young infant received a woodstove with chimney (n=269) or remained as controls using open wood-fires (n=265). The main improved health outcomes assessed were acute lower respiratory infection in children (approximately one-third reduction in severe pneumonia) and respiratory health of their mothers. There was a reduction in the mother's carbon monoxide exposure, but a statistically significant effect on lung function was not established. Subjectively, the women reported that the use of the improved stove in their household significantly reduced the prevalence of sore eyes and headache over the study period.

Harris et al. (2011) published results from implementing the type of stove contained in this research document—the ONIL stove. The ONIL stove was installed in more than 90% of the homes in a rural Guatemalan community between 2002 and 2006. They compared the number of clinic visits for acute upper and lower respiratory illness before and after installation of the stove. Combined upper and lower respiratory illness decreased by 26% and for acute lower respiratory alone, visits to the clinic decreased by 45%.



*Figure 3. ONIL stove in use*

### **Evaluations and Perceptions of Improved Cookstoves**

Given the popularity of new, improved cook stoves in these rural areas; there has been analysis regarding the success or failures of each of the projects. It is relatively easy to initially build a new stove in a rural household, but long term implementation and utilization is always

the desired end point. For example, Tinker (1987) documented that for women in Guatemala using their *Lorena* stove, faster cooking time was often more important than fuel saving to the user of a potential stove. The involvement of women is also emphasized in these projects. Lack of involvement of women in the project has been identified as one major factor contributing to poor uptake and sustainability of improved stoves (Dutta, 1997). Anecdotal reports would state that households initially respond most to fuel savings, speed of cooking, convenience, compatibility with local cooking practices, and status of modernity, and relatively less so to pollution related issues (Ruiz-Mercado, Masera, & Zamora, 2011).

Qualitatively, it is often difficult to assess success of the stoves. Typically, with any of these stove improvement projects an interview component is included with the quantitative analysis. These interviews are often completed in order to re-educate the community members regarding stove use and troubleshoot other areas of implementation. When the stove is presented at a low or discounted cost to a community member, one study questioned the veracity of their own results of symptom reduction with a perceived tendency to give socially (and researcher) approved responses by community members (Diaz et al., 2008). That same study, though, of nearly 100 Guatemalan women documented a 52% rate of self-reported health improvement. Additionally, 88% of those who found that a reduced amount of smoke with an improved stove linked that smoke reduction to an improvement in one's own health. Notably, however, Troncoso, Castillo, Masera, and Merino (2007) developed a case study of improved cook stoves in rural Mexico and reported observed reasons for implementation of improved stoves by community members such as reduced smoke, better for health, saved fuelwood, allowed more family members to use the kitchen when a fire is lit, and it was aesthetically pleasing.

The RESPIRE trial in Guatemala explored self-health perceptions showing that most women felt that their health had improved with the use of the new stove, but only half felt that it had improved their children's health (Smith et al., 2011). A reduction in sore eyes was most frequently mentioned along with improved cooking position, shorter cooking time, and less worry about child burns. The most common complaint about the stove was a longer time required for cutting wood to fit in the confined loading area of the stove.

### **Context/ Background**

The rural town of Jacaltenango, Guatemala, sits in the Western Highlands of Guatemala. In 2008, census population estimates were 41,112 (Instituto Nacional de Estadísticas, 2008). Not unlike the rest of Guatemala, in Jacaltenango and the surrounding communities, wood is the main source of cooking fuel and the stoves typically are inadequate, traditional, and poorly ventilated constructs that are usually three-stone open fires or slight modifications of that model.

Refugees of the Guatemalan Civil War (1960-1996) founded ETESC after they returned to Guatemala to attempt to rebuild the country they fled. Today, ETESC is a non-profit with goals of providing health care, legal accompaniment, and education to each of the communities with which it works, through incorporating health promotion and environmental health (PIH, 2011). PIH and ETESC are partner organizations and have been so for nearly two decades. Together they identify and implement public health initiatives in the areas surrounding Jacaltenango.

The town of Jacaltenango serves as the central operation of ETESC and its clean cook stove project. There are several smaller communities in the mountainous surrounding areas—Lupina, Laguna, San Marcos, Xayolomaj—that make up the rest of the five project communities. They are all easily connected by short (15-40 minute) drives between them. The surrounding

communities are all smaller in population, however, similar in most other demographic variables such as people per household, access to consistent work, and possession of luxury items (i.e. cell phones or televisions).

Jacaltenango is largest by size and population, the size of a small town in the United States, and serves as a central transportation hub of the surrounding communities. There are two-lane paved roads with shops and a market, a central square for events, an old style church, and multi-level homes. Most of the homes receiving the improved stove, however, were the interspersed homes on the fringes of town that had noticeable poverty—one-room huts, some dirt floors, overcrowded living spaces, and relatively limited resources compared to their neighbors.

Lupina is a very rural locale. Residents live in the valley between two mountains. The ‘downtown’ area containing the school, church, and a few smaller vendors is surrounded by homes scattered up each of the mountain sides. There are no paved roads, only beaten down dirt paths by cars, busses, and foot traffic. Most every home only has a dirt floor and one room functioning as kitchen, bedroom, living room, and other miscellaneous needs for a family. The homes are makeshift constructs of sheet metal, lumber, and other spare materials. The people are incredibly welcoming given their relative isolation and the rumor was that I was the only ‘gringo’ anyone could think of that had spent a night in the community.

Laguna is a bit reminiscent of an American Old West town. It sits just off one of the asphalt two-lane highways. It consists of a few well-traversed dirt roads connecting a network of dozens of homes. This community is very well connected—everyone seemed to know their neighbors and fellow community members. Several homes were cinder block, multi-room homes, often connected with a shared common backyard with family members.



San Marcos is a relatively urban locale, second largest in size compared to the downtown Jacaltenango. Mostly lined with paved roads, this community relies heavily on coffee growing for income. The highest elevated community, its days are often cloudy in the rainy season with a misty, foggy rain leading to chilly evenings, contrasted with scorching hot, dry summers.

Xayolomaj is a green forest laden community built on one side of a large mountain overlooking a vast landscape near Jacaltenango. In the distance on clear days, one can see neighboring Mexico. The largest structure in the entire community is the three-room school—only elementary education is offered. Muddy trails connect the homes to one another with one main path highly trafficked with pickup trucks offering rides into the larger city of Jacaltenango.

With the gracious help of Green Mountain Coffee Roasters a grant was obtained by PIH that sponsors an ongoing three-year effort for PIH and ETESC to impact the environmental health, and hopefully in turn improve the economic conditions, of the residents of Jacaltenango and its surrounding communities. From within the five communities, a total of 175 households were selected based on need to be involved in the three-year grant project. In a series of pre-intervention workshops, each community was collectively given the option to select the first intervention of the grant from various choices relating to indoor air pollution, water filtration, water storage, etc. In these workshops, community health workers led seminars providing education to the women residents. The topics included environmental health issues specific to potential interventions. All five communities selected the improved stove project as the intervention for year one.

In July, 2011, PIH and ETESC co-directed the delivery of ONIL stoves to each home in the communities. The ONIL stoves were purchased from HELPS International at a price of ~\$111 USD each and subsequently presented to each household free of cost. Participants

‘earned’ the stoves through a time investment with the aforementioned workshops. One hundred and seventy-five homes received stoves. Projects in the upcoming years will likely involve the installation of water storage tanks, water filters, and/or other environmental health improvements based on the same community decision-making process.

### **Methods**

During the month of October, 2011, PIH and ETESC’s community health workers (CHWs) and I performed a modified Rapid Assessment and Evaluation (RARE) analysis of the use of the ONIL stoves in the area in and surrounding Jacaltenango (Trotter, Needle, Goosby, Bates, & Singer, 2001). Though RARE is intended for high-risk community situations such as HIV/AIDS epidemics, it was easily adapted to the stove project. The research performed here used key informant interviews, direct observations, and surveys of not only community members but also people such as the CHWs and other staff members to establish a broad context to the stove implementation. Other typical RARE methods such as geo-mapping and focus groups were not used. The use of a variety of methods to study one problem is called methodological triangulation (Patton, 2002). Data triangulation involved comparing the different data sources collected from the various people within the five communities in addition to the information provided by the five CHWs and the intervention staff. The use of multiple methods (qualitative interviewing, survey, participant observation) and of different data sources (people from each community, CHWs) provided evidence about consensus and conflicting view regarding the stove implementation as well as a comprehension of the stove intervention in a wider social perspective.

Qualitative and quantitative interviews were performed together at 23-25 randomly selected homes of the 175 that received the stove (n=118). In order to elicit opinions regarding

the improved stove and its use, I completed in-depth, qualitative interviews with the primary user of the cook stove—the vast majority of the time this was the eldest woman in the home. During these interviews, I obtained in-depth information regarding the immense impact of the improved, ONIL stove. My Spanish is fluent; therefore, no translation was necessary.

Participant observation of those homes using the stove throughout the day also provided other insights, otherwise unobtainable. I spent nearly 36-72 hours in each community staying overnight in homes that had installed and were using the new stove. This provided insights the women and family members did not think to volunteer during the interview process or behaviors they did not necessarily realize had changed. In other words, when the participant observation was matched with the opinions explored in the qualitative interview it was possible to confirm some of the opinions that were said as well as discover variations between what people said and their actual behavior including what they did not talk about.

Ethical approval was jointly obtained from Wright State University's Institutional Review Board (IRB) in Dayton, Ohio, as well as the IRB at Brigham and Women's Hospital in Boston, Massachusetts. Study participants were given fictitious names to protect their anonymity. Photography was used to document the various ways the ONIL stoves are being used and bringing changes to everyday life.

During the month of ethnographic fieldwork, I familiarized myself with the various communities in and around Jacaltenango and made community visits to those locations. I initially acquainted myself with ETESC and PIH's partnership with the stove project. ETESC and PIH have a similar mission for working with the poor and displaced around the world. For decades they have worked side by side in order to improve the health of those in rural Guatemala. Some of their more recent projects have dealt with cervical cancer screening, chronic

disease management, and socio-legal accompaniment with regards to those affected by the Civil War. Conversations occurred with the women of the homes using the stoves, the five community health workers charged with being the on-site leaders of the project, as well as the ETESC and PIH staff.

Each household visit consisted of an initial weighing of wood to determine usage of the wood over the course of 24 hours based on follow up weighing of wood leftover the following day on a return visit. Weights were obtained in pounds using a rudimentary *romana* balance.



Figure 4. *Romana* balance used to weigh wood

This weight data was then compared to a previously obtained weights of wood used with each household's previous stove model during the March and April of 2011. At the same time, I conducted a survey asking about self-perceptions regarding the presence of various health symptoms. A qualitative interview then followed with a series of open-ended questions regarding the stove. The qualitative interview consisted of the following guide questions:

1. Do you like your stove? Why?

2. How is your stove working?
3. What do you not like about your stove?
4. What changes have you made to the stove?
5. Was the stove what you hoped for?

Utilizing the RARE model, the CHWs asked similar questions of the remaining households during the rest of the month. This front-line researcher empowerment is characteristic of the RARE model in cases where the primary researcher is unable to personally perform all evaluations. At the end of my month in Guatemala, each CHW had the opportunity to present his or her findings to me in informal exit interviews, which covered the stove project as a whole.

Following each household visit and interviews with community members and CHWs, field notes were written by hand and later typed in order to facilitate qualitative data analysis. I analyzed the data in an inductive way through applied thematic analysis (Guest, MacQueen, & Namey, 2012). Thematic analysis was employed to group the common themes and perceptions regarding the stoves—both those seen previously in the literature as well as new thoughts. These perceptions included positive benefits regarding health, social interactions, home environment, dignity, and safety. These themes were contrasted with negative impacts such as installation barriers, size constraints, seasonal barriers, and isolation. Before leaving Guatemala these findings were shared with PIH and ETESC leadership in order to improve future environmental health initiatives and to take any potential corrective measures with regards to the improved stove project.

## Results

### Description of Participants

One hundred and eighteen, randomly selected, households were interviewed before and after the stove intervention. All homes had their wood weighed twice in a 24-hour period and quantitative data obtained. Every household answered the questions from the qualitative interview guide. Demographic information was obtained for the identified head of household in order to facilitate follow up. The head of household and the person who used the stove was always identified as a female whose age (when known) ranged from 17-72 years old. These heads of households used the stove the most of those who lived in the home. Various demographic characteristics were obtained to potentially identify trends in analysis (Table 1). In looking at the pre-intervention demographic data, it was interesting to note was the high number of homes using open fires. Additionally a high number of *plancha* style stoves were used in the communities prior to the intervention. These *planchas*, however, were commonly old, inadequately vented, and functioned similar to open fires (Figure 5). The homes typically had an average of five inhabitants, of which one was usually a child under the age of five (see Table 1). The literacy rates were high except for San Marcos where the percentage was lower than the other communities. The ownership of various luxury items was rather inconsistent across communities, but lack of luxury items did give an indication on an individual basis whether a particular household was likely to have an open fire and therefore more smoke exposure and potentially have the greatest benefit from an improved stove. People rather consistently owned cellular phones, televisions, and radios, but luxury items such as vehicles or refrigerators were less prevalent.

Table 1. *Demographic Information of the Five Communities*

	Laguna	Lupina	San Marcos	Jacaltenango	Xayolomaj
# of Households	23	23	24	23	25
Avg # in Household	5.0	5.0	4.8	4.7	5.7
Avg # <5 years old	0.6	0.7	0.9	0.7	1.5
% able to read	80.0	80.0	50.0	96.0	70.0
% able to write	70.0	80.0	50.0	91.0	70.0
Have you worked in last 30 days (%)	80.0	96.0	30.0	20.0	80.0
Anyone else worked in last 30 days (%)	80.0	20.0	20.0	0.0	20.0
Do you own(%)...					
...Radio	70.0	26.1	58.3	66.7	92.0
...Motorcycle	13.0	4.3	0.0	4.2	0.0
...Refrigerator	17.0	0.0	4.2	25.0	4.0
...Television	57.0	56.5	54.2	75.0	80.0
...Car	0.0	0.0	0.0	8.3	0.0
...Stereo	8.7	30.4	8.3	8.3	0.0
...Cell Phone	8.7	78.3	91.7	83.3	12.0
Old stove was a...					
...Open Fire (#)	14	20	10	11	22
...Plancha +/- chimney (#)	8	3	14	13	3
...Gas stove (#)	1	1	0	12	0

Figure 5. Old, poorly-vented, previously used *plancha*

### Wood Use Reduction

The weights of 24-hour wood usage while community members were still using their old stoves established baseline usage information. This average provided a comparison to a 24-hour measurement of wood usage with their new ONIL stoves. This initial follow up study established a reduction in wood use in each of the five communities as well as cumulatively (Table 2).

Within the five communities, wood use fell 38.18-55.8%. Overall, average wood use dropped by nearly 48%. This comes close to the published data of the ONIL stove available from Helps International, which claims a 70% reduction in fuel use (Helps International, 2004). This is an initial one time weighing of the wood and it is estimated that results could approach the 70% data in the future with continued use and further utilization by community members. There were a few confounding factors with regards to the rainy weather and women using the same wood designated for the day while not using the ONIL. For example, more than once a woman used the designated wood for heating a large pot of corn on her old stove—wood that the next day was measured as an increased usage rate because of cooking it over an open fire. Future measurements will potentially have a more accurate representation given the communities continued receptiveness to the research and intervention.

Table 2. *Wood Use Reduction for the Five Communities, 24 hour averages*

	Use Prior to ONIL (lbs)	Use with ONIL (lbs)	% Reduction
Laguna	16.42	9.16	55.80
Lupina	31.65	14.09	44.52
San Marcos	42.23	16.13	38.18
Jacaltenango	30.14	16.59	55.04
Xayolomaj	37.73	17.41	46.14
Overall	31.63	14.68	47.94



## Health Impacts

During the quantitative portion of the interview, participants were asked yes/no questions regarding presence of cough, eye pain, headache, and back pain during or soon after cooking during a given day (Table 3). In qualitative interviews after responding to the questions in Table 3, the women mentioned nearly every time the decreased smoke and its subjective feeling of good health. It appeared to be a reflex response from most of them. Immediately after the initial question regarding what they thought of the stove, they quickly responded that the decreased amount of smoke was a great improvement. Many members of the community were apparently conditioned to the plumes of smoke within the home and lived with it for decades—leading now to them almost appearing shocked at how much a difference the ONIL made. When asked, many women did understand that the smoke was harmful; however, alternatives in stove construction were often unavailable.

Table 3. *Perceived health symptoms of inhabitants, before and after the stove intervention*

<b><i>While cooking or soon after, do you experience...</i></b>								
	<b>...Cough(%)</b>		<b>...Eye Pain</b>		<b>...Back Pain</b>		<b>...Headache</b>	
	Before	After	Before	After	Before	After	Before	After
Laguna (n=23)	43.5	0.0	100.0	0.0	26.1	0.0	87.0	4.3
Lupina (n=23)	56.5	0.0	82.6	4.3	30.4	4.3	1.0	47.8
San Marcos (n=24)	58.3	12.5	54.2	16.7	70.8	62.5	88.0	33.3
Jacaltenango (n=23)	60.9	4.4	95.7	34.9	84.8	39.1	91.3	34.8
Xayolomaj (n=25)	4.0	0.0	2.0	4.0	2.0	0.0	2.0	4.0
Overall (n=118)	44.6	3.4	66.9	12.0	42.8	21.2	53.9	24.8

As seen in Table 3, all of the symptoms experienced while cooking dropped by a large percentage in not only each of the communities, but also when averaged collectively among the five communities. The reduction in presence of eye pain by 58% was the highest—likely attributable to the decreased smoke when standing over the fires during meal preparation. The

collective reduction in cough (41%) could also be linked to the absence of smoke clouds within cooking areas. The second two symptoms, however, are often more chronic conditions. For instance, back pain related to height of the stove was assessed given the opening statement of “while cooking...” No matter what improved stove intervention was done in a community, a woman with chronic back pain for any number of reasons would potentially not report a significant change in symptoms. The same can be said with regards to headache. When examined on an individual community basis there was likely some confusion on behalf of investigator, households, or both, in a community like Xayolomaj, which had significantly, lower reported presence of cough, eye pain, back pain, and headache when compared to other communities.

One of the more startling health impacts noticed was in the poorer, one-room homes. These homes were often younger couples with a small child or children living in the home. With such limited space, a baby crib or child’s bed sat only a few feet from the stove. Given the previous stoves’ open-air ventilation, many women were very pleased with the new stove’s ability to reduce the smoke exposure to their young, growing children who had limited options regarding where they could sleep.



*Figure 6.* Often the family’s bed(s) were a mere feet from the stove

With the cook stove's most common use being to cook meals there were health impacts mentioned specific to the food itself. Maria, from Xayolomaj, mentioned she loved the new stove because the food she prepared for her family no longer had ash and other particulate matter contained in it. Her appreciation of clean food was obvious. Perhaps, a more evident health impact with regards to food was the idea that many women could buy a wider variety of foods. Since the installation of the improved stove, many families now noticed that they had an expendable income due to a decreased need to purchase wood and less time spent gathering wood. The newfound 'free time' was now potentially being spent finding more paying jobs. This expendable income was now spent on food items such as chicken and other meats and more nutritious foodstuffs. The nutrition effects are hard to quantify at this time, but the reality is that there is a health net positive to including meats on a regular basis in a diet otherwise exclusively limited to rice, grains, and collected, seasonal produce.

### **Social Interactions**

With the presence of an improved stove, many communities found their social interactions altered. Dozens of women claimed they enjoyed the new stove because family and friends were able to come over to the house and utilize the stove together. In the past, in these homes, cooking was often a solitary act where a woman was tethered to the stove during the day spending hours to tend to a fire and cook the daily tortilla load. To say that tortillas are a food staple is likely underselling the corn-made flatbread's importance. Each household makes many dozens of tortillas each day. Some make them all at once in the morning; others choose to make a smaller amount before each meal. Most women surveyed claimed that tortilla making was noticeably easier with the ONIL stove due to the large cooking surface and ease and speed of heating the surface itself—a fact that has dramatic impacts. Word would often spread to friends,

family members, and neighbors and frequently several women were cooking their family's tortillas spending time chatting about the daily events in the community. The ability to affect the tortilla cooking process is potentially the largest impact of the ONIL given the amount of time spent in a given day while cooking tortillas.



*Figure 7. Social stove activity, with groups of neighborhood women increased dramatically*

In some cases, however, social interactions changed in a negative way. In some of the more population dense areas of Jacaltenango previously, some three-family homes utilized the same stove. These multi-family homes built the ONIL in the cooking (and sometimes living) areas of these family homesteads. Effectively, what occurred was a splitting of intra-family interaction. Granted, the unlucky woman, Rosa from Jacaltenango, who in the past waited several hours to cook for her family no longer had to wait as long, but the interaction that occurred with her two to three other friends and family members during that waiting time was noticeably absent—something she misses.

The social interaction within a family, however, typically improved. In addition to a decrease in smoke and increase in safety of the stove, Candelaria, of Lupina, could not fully describe her delight with the new stove related to her ability to keep her children in the kitchen while cooking. In the past, she would send the children outside or into other rooms while

cooking. For the past several months, however, she truly enjoyed having them sit with her and discuss things such as school work and do other activities otherwise impossible previously.

Manuela, who lives in San Marcos, mentioned the ability to include her female children in the cooking process now—an extra hand in the kitchen but also a social teaching process that she valued greatly.

One nineteen year-old woman in Laguna, Nirolasa, stated something quite interesting with regards to the changed social interactions within her community. She claimed that given the significant wood use reduction, the loads necessary to bring in from the nearby forest were lighter. Now, she and several other women in the community of Laguna were able to join in the wood collection process. This type of involvement is somewhat unheard of according to her. It no longer meant that she had to stay near the home in order to cook, clean, or do other expected activities. The simple walk out to the wooded area to essentially pick up sticks together was a liberating experience for her and her friends.

The mere design of the project itself shook up the community's social organization. PIH and ETESC identified households and expected the women to take the lead on not just the stove project's implementation, but even before that, by deciding as a community which type of intervention was best. In a Latin American patriarchal society, this was a shake-up of the social hierarchy. These interviews took place during the day when the males of the home were often absent so assessing their opinion was often difficult. According to the CHWs, however, the involvement of women has not necessarily been contentious, just an exception confronting the social norms in each community. The continued involvement of ETESC and PIH will potentially demonstrate if this shift persists or if it continues to change as women in the community continue to make more decisions regarding the interventions.

## Quality of Life

Within the home itself, many women identified changes that were hard to quantify. For example, countless women expressed pleasure with the fact that the fires no longer permanently charred their cookware. With traditional stoves, the pots sat directly on or in a fire, leading to a charred, carbon sediment, black layer impossible to remove on all kitchen items. The ONIL stove allows a cooking surface removed from the flames itself and therefore saves pots from the long-term discoloration. The chimney, when properly installed, also prevents smoke damage of the walls and nearby household items. Similarly, a few women noted that the stove no longer left their hair and clothes smelling of smoke at the end of the day. This sense of improved self-dignity was apparent in the pride they all took in the stove. Numerous women stated that they liked the stove specifically because of its appearance, noting, “It looks nice.” In an environment of desolate poverty, a concrete stove can be a welcome addition to each of the families.



*Figure 8.* A new stove installed over a location of a previous stove; the area behind the stove has been scrubbed and painted over

A Lupina resident, Catarina, told a story regarding the changed home environment. The previous stove had been located in a room offset from the main living room. They did not use the

room for other things because of the smoke and open flames. The day the CHW and I arrived, however, they converted this area to a study room for the three children who lived there—complete with a desktop computer. They put the ONIL stove closer to the dining area given that the chimney removed the noxious smoke. Seeing a computer in this environment was startling. Catarina could not have been prouder of her family's new addition and it was the first thing she wanted to show us. She could do nothing but continue to talk about how things have changed with the new stove—her family's quality of life had improved far beyond the simple new stove that made cooking tortillas easier.

Luisa Rosalva from Laguna showed me her family's previous stove—a 55-gallon steel drum with a section cut out to place a grill frame. The effect of the new stove was remarkable. In the place where the drum used to sit, a black wall stain stretched vertically nearly twenty feet. The thought of reaching in to handle any food the way she had to reach into this drum seemed absurd and incredibly dangerous. She was very proud of her new stove, but perhaps she was more proud that the steel drum now served as the family's outdoor garbage can.



*Figure 9.*

Left. The 55-gallon drum now used as a trash can outside the family home

Right. The destruction left behind from the 55-gallon drum stove; to the right is the improved ONIL stove with a chimney vented outside the roof.

**Security/Safety Improvements**

As alluded to previously, the ONIL stove is a much safer model than any traditional stove. The flame is nearly entirely contained, elevated and hidden from view. Many women I talked to had a direct family member who had been burned at some point in the past. These burn stories ranged from the benign, now healed scalds to the permanent disfigurement of children as young as two years old. Nearly all women appreciated the safety of the improved stove. Depending on the type of stove utilized previously, some women mentioned the personal safety afforded by the ONIL. No longer were women's arms at risk for burns incurred while reaching over the stove to move pots and pans. Pregnant women also noted that with their larger abdomens, the ONIL granted a more 'forgiving' area in which to work.

A woman in Jacaltenango named Manuela Isabela stated that the ONIL stove requires less wood, which she considered a safety benefit. With the older model stove she used, she used a significantly larger amount of wood to heat a pot of water. For her, the ONIL requires subjectively a third the amount of wood in order get the same pot to boil. This means that the size of the fire is not as large. When finished cooking, she no longer has a large pile of embers or a half lit log needing to be extinguished and discarded. For her and her family, this act of putting the fire out was consistently dangerous with flying embers hitting people or other items in the area of the stove.

**Economic Implications**

Many women offered insights regarding the economic implications of the improved stove. First, for the families that purchase their weekly wood, the improved stove meant that they had to purchase less. By purchasing less, there is more expendable income within the communities—a benefit already described above.



In smaller, more rural communities such as Laguna and Lupina, consistent work by males is often hard to find for various reasons. They often rely on the work opportunities at local chicken farms or other agricultural industries. Most families experienced the impact of limited work options for any number of reasons: a numbers game where there are just fewer jobs nearby, a seasonal ebb and flow related to harvesting crops, or lack of other vocational training. By reducing the need to find wood nearby, the men were thus able to explore more consistent work options. It was unclear at this point in follow up whether these job prospects were adequate, permanent, or sufficient.

One example, though, in Jacaltenango possibly demonstrated an economic benefit of switching to the ONIL. Livia's family owned a propane-tank gas range grill that they often used. Every two to three weeks they had to purchase a new propane tank for 130 Q (approximately \$16 USD). When they were selected for the ONIL stove project, however, their economics changed. She described that using the ONIL stove is more efficient, cheaper, and more realistic for her family's energy needs. They could now rely on wood as a fuel source and have more financial security without sacrificing any effectiveness of the stove itself.

### **Community Environment**

Many of the women volunteered some feelings on their local environment as well. They explained that using less wood with their improved stove was better for the environment and their local forests. Subjectively from my interaction with them, those who reported this as a benefit or something they liked about their stove tended to be younger and likely to be enrolled in school potentially suggesting that such topics are discussed in the school system in the area.

An observation made during several interviews was the use of not just wood as a fuel in the cook stoves but the tendency to use other fuel options, specifically garbage and plastic. The

fire burned throughout most of the day and on more than one occasion a family member would throw an empty plastic bag or other container into the small opening for the stove. Despite ventilating properly and with the impact of burning biomass established, burnt plastic is likely to have similarly or potentially worse health effects.

### **Installation Difficulties**

Part of the follow up analysis of the stove project tried to identify those who had modified the stove in some fashion. These adaptations often involved a widened opening to enable a larger size of wood into the stove. Otherwise, alterations were limited to adding a specialized table on the side for storage of pots and pans not in use. Though not rare, the modifications were not often a problem; rather, the primary installation was often not sufficient.

The most common sign of poor installation was a poorly located chimney. Throughout each of the five communities, there were chimneys that were still contained below a roof or barely outside the home that were incapable of reducing the indoor air pollution to maximum levels. The purchased and delivered ONIL stove construct only came with three aluminum chimney pieces. If a particular home had a roof that was higher than reached by these three, they were expected to purchase additional extensions. Many homes, mostly for financial limitations, chose not to purchase the extensions.



*Figure 10. A woman using both stoves at the same time*

There were also the rare (n=4) cases where families did not install the stove at all. The reasons given for these cases usually involved a reluctance to purchase additional cinder block to prop the stove up to the desired location in the home or an inability to purchase a chimney addition that would vent the stove outside the home. There was one case where another male family member did not want the stove to be installed. Interesting to note, however, was the report from the CHWs at the end of the month that the four homes that had not installed the stove at the initial follow-up, had all installed the stove soon after the initial follow up visit.

Especially in places like Laguna, many women used cooking areas with multiple women using their own cooking arrangements. The installation of an ONIL stove did not require the destruction of the old traditional stove. This led to many homes having both an ONIL stove as well as an older traditional model next to it that was frequently also used. An exact number was not obtained for the families that kept their old stove functioning, however, subjectively it appeared to be just below 50% of the 118 homes still had access to a previous stove model in the home.

### **Size Constraints**

The *plancha* (cooking surface) of the ONIL stove measures 18"x 24". This is larger than most traditional stoves allow, but it is somewhat limited. It is difficult to cook large pots on the ONIL stove given space and weight constraints. The month of October, the time of this data collection, is also guisquill season and provided an opportunity for me to observe a cooking surface size constraint of the ONIL stove. Guisquill is a pear-squash type vegetable that must be boiled for a long time in a large pot containing many pieces of guisquill. This vegetable is a mainstay of a family's diet during this season. The pot used for boiling guisquill does not fit on

the ONIL cook top and the women return to using their old stoves. The benefits of the ONIL stove are then diminished.

The improved stove also has a constrained opening for inserting the wood to burn. This small space requires the men and women of the communities to chop the typically used pieces of wood into smaller more manageable pieces. In discussions with Glenda and her husband in Laguna, they both described that the cooking process requires more physical preparation time with chopping wood, however, they were unwilling to trade the potential health benefits of the ONIL for their older stove.



*Figure 11. An elderly couple chops a larger log in order to use it in the ONIL*

### **Seasonal Barriers**

The month of October is part of the rainy season in Guatemala. With men still working outside, many of them come home at the end of the day with dripping wet clothes. These same clothes need to be ready to use the next day and outdoor line-drying, as is done in the summer, is not feasible with the frequent and unpredictable torrential downpours. The community of San Marcos contended that the old stoves had a rapid ability to dry clothes given the size of the fire and its open air ventilation. Some used the old fires to dry clothes. In other cases, however,

families made unexpected adaptations to the ONIL stove, such as lying clothes directly on the *plancha* in order to facilitate drying.



Figure 12. Drying clothes with a traditional stove, with an ONIL nearby

Similarly, families often collect their wood for the week on a particular day. If the day prior had heavy rain, the collected wood was wet and would be difficult to ignite on its own, without the help of several larger pieces of wood. Many families, thus, were less apt to use their ONIL stove on these wet days because the larger pieces of wood in a pile could not be placed in the entry point for the stove. What I typically saw, was that if a day had particularly hard rains, then the following day many women would revert to using the traditional stove—it was easier to deal with than struggling to keep a single wet log lit long enough to cook a meal. Rough estimates were that nearly 50-60% of the homes still had access to their previous stove and sporadically used it for various tasks.

Not only is the rainy season a barrier with regards to wet and dry wood, but given the elevation of these mountainous areas, the rainy season also means colder temperatures especially at night. Many families used the open fires as a functional space heater during these months. It was often a complaint when discussing the new stove that it was “too efficient” and contained the heat too much. Similar to the wood size issue, however, the women and families very much

agreed that the trade off with the new stove was more beneficial than the uncomfortable cooler nights. They have simply adapted by wearing more clothes, sitting even closer to the ONIL, and sleeping with more blankets.

### **Free Time**

In various discussions, women mentioned that cooking using the ONIL was faster than what they used previously. They attributed this to the combination of the ability to use two pots at once and the more efficient thermal exchange touted by the ONIL. What was hard to establish was what was being done instead, now that the women spent less time in front of the stove cooking. Estimates from the women about their amount of free time ranged from an extra half hour to three hours in a given day. Most of the women stated that the free time enabled them to do more housework such as cleaning and home maintenance. The point is not to discount this, but rather to question whether this increased home activity holds true six, twelve, or eighteen months later, or if alternative activities will enter into these women's lives that in the past they were too busy to maintain.

### **CHW Involvement**

The five CHWs employed by PIH and ETESC are aged 20-26. The four women and one man that make up the CHWs all live in the communities for which they are responsible, serving as on the ground eyes and ears for implementation, troubleshooting, and reporting back regarding the environmental health initiatives. They each pointed out that the communities appear more united with these new projects. For example, prior to this RARE evaluation community meetings led by the CHWs were able to identify households that had problems with the stoves (i.e. not installing) and worked together to troubleshoot those issues. According to the CHWs, this sense of community was not easy to identify prior to the stove project. This idea of

coming together and helping their neighbors, relatives, and friends is promising for community unity going forward.

This CHW involvement is an interesting model of direct resident leadership, one that has not been fully explored in the literature. CHW research in the past has shown the ability for CHWs to serve as a cultural broker (Dietrick et al., 2010), to provide culturally appropriate health education (Swider, 2002), to build individual and community capacity (Brownstein et al., 2007), and even to provide direct health services (Ayala et al., 2010). The stove project involvement as in this case is unique. Each CHW had their own motivations for becoming involved—enjoyment of the outdoor work, satisfaction with a charitable project, desire to work in environmental health, wanting to work with groups of people, etc. What was interesting was the empowerment that they not only sensed within their communities in ‘self-directing’ a project, but the empowerment that goes along with being a young age and the leader for such a large scale project. One CHW, Ariel, loved that she was able to tie her environmental engineering education into this type of charitable work. Another, Lucy, felt that her planned degree in nursing parallels this type of public health work. They each had their own insights into the project, things they would have done differently, and things they thought went well. All five, not surprisingly, struggled with how to determine which homes received the intervention given the wide-spread poverty. Demand was high initially and a collective decision was often made about who was more in need within the communities. The hope is that with this kind of youthful involvement and energy, future projects balancing research and service will continue to be successful, well directed and well led.

One of the more encouraging findings of this CHW involvement is in its successful framework. The PIH and ETESC models of accompanying service balanced with a research

interest. They choose not lead from the front and instead stand side by side with community members in an attempt to correct health disparities and poverty. It would have been easy to show up with the stoves, install them with a well-trained construction team and be done with the project. However, the sustainability of that model is suspect. Instead, with a long-term goal in mind of fighting things much broader than indoor air pollution, the PIH and ETESC project uses CHWs and the direct community involvement in order to have the largest, longest lasting, and meaningful impact on the community.

### **Discussion**

Throughout the assessment of the stove intervention one thing remained clear—the impact of the stoves was far reaching. The reduction in wood use was measured, but in talking with the residents of the communities, it was apparent that much more had changed in the makeup of the community.

### **Public Health Implications**

Residents articulated the health changes for the families of those who received stoves. Nearly every house mentioned the reduction in smoke since receiving the improved stove and its ability to reduce the prevalence of cough, headache, eye pain, and back ache shown in Table 2. Beyond the absence of plumes of smoke, the women now have improved access to better quality food—no longer containing contaminating sediment and now able to purchase a wider variety of food. The safety of the ONIL will affect the lives of every child that grows up in these communities for many years to come.

Beyond the common perceptions of health, the mental well-being of the community had a significant improvement because of the stove. Social interactions, community unity, and family cohesiveness noticeably improved. The stove no longer was a figurative ball and chain that



tethered a woman to her post for hours upon hours in a day. Communities grew closer together, both within the household and also collectively. These communities united behind this project, made important decisions as a group, and have seen its immediate effectiveness. This only bodes well for future public and environmental health projects.

The economic structure changed although was not yet fully measured. The reduction in amount of wood to be collected led to an increased amount of free time for both men and women and more time to look for employment and work outside the home. The potential for freedom from the described ‘poverty trap’ as described by Duflo, Greenstone, and Hanna (2008) is an exciting potential result. Economic development and its potential for a direct impact on health would be yet another of the far-reaching impacts of the stove project effects.

Environmentally, less wood use means a reduction of deforestation. This study did not directly measure deforestation impact, however, the women were very aware of the potential influence. Each community received a relatively small amount of stoves, but the wood-use reduction was dramatic. A reduction that, when extrapolated, could directly address a growing public health issue in Guatemala and around the world.

### **Future Goals**

The partnership between ETESC and PIH is a continually developing joint effort. The improved stove project is one that, while initially effective, will require close follow up in the future for continued success. Within a model of dissemination and implementation research as defined by Rabin, Brownson, Haire-Joshu, Kreuter, and Weaver (2008), the dissemination process was effective in which the time spent prior to the intervention and the availability of the CHWs led to an enhanced initial uptake and utilization of the stoves. The implementation aspects showed a good amount of lack of fidelity when transported to the real-world utilization of the

stoves. Many women either adapted their stove or used a combination of old and new stove in order to complete daily tasks (Rabin, Brownson, Haire-Joshu, Kreuter, & Weaver, 2008). The initial fears of widespread non-installation or drastic modification of the stove evaluated upon follow up were not entirely realized, but a significant proportion of homes had improper installations. This means that an adjustment to the stoves assuring properly ventilated chimneys needs to be made. These adjustments are minor, but important. This would provide the full benefit of the improved cook stove. The chimney extension pieces are only 30 Q (~3-4\$ USD) and could be relatively inexpensively provided to the communities requiring the adaptation, but for whom finances are a barrier.

Perhaps, most important, is to continue with proper close monitoring and evaluation with regards to the qualitative observations. In the coming months women may have more useful perceptions and observations to report about their stoves. It will be important to discover which findings will persist and which will disappear.

With regards to the three-year project embarked on by ETESC and PIH, it will be important to continue with the pre-intervention community based workshops for future interventions. The women were generally aware of what to expect with their new stoves before actually receiving them. In the future, with a water tank or filter, it will be important to facilitate that same learning process. This learning process potentially encouraged a high utilization rate that was observed in this research.

### **Limitations**

The limitations in this research were many. First, the CHWs did an excellent job making this research possible. However, it was each CHW's first time performing research of this kind. Some of the data was inconsistently obtained. For example, there was some incomplete

demographic information or other inconsistent methodology with regards to the weighing of wood (i.e. different balance used, slightly different instructions to women). The practice of continued monitoring and evaluation with future planned interventions will likely improve this process.

As discussed above, the stoves have only been installed for a few months; therefore, some complications or problems with the stove may not be obvious at this time such as long-term maintenance or durability. The interviews were also rather brief. Both of these issues can only be addressed with continued close monitoring and evaluation of the intervention and close attention to the residents of the communities including continued focus on development of relationships.

Follow up questions in a study design such as this can be inherently problematic. ETESC and PIH purchased the stoves and installed them free of cost to the recipient. Three months later a ‘representative’ of those two organizations came to ask questions about the stoves. It is possible that the answers obtained were intentionally positive for fear of some unknown retribution. This does not discount some of the other observations, but does insert a “social desirability bias” that is intrinsic in this type of research. Continued discussions and evaluation of the project will lead to an increased trust level with each of these community members and potentially reduce this bias.

### **Future Consideration for Research**

In further assessment of improved cook stove research there are many avenues to pursue. What would be most interesting given these results would be a more comprehensive qualitative analysis with an exploration prior to the improved stove’s installation. This would give a much better comparison as to what kind of shift occurs within communities when involved in a project

such as an improved cook stove project. This would only more comprehensively evaluate the stove intervention and lead to more effective future stove projects.

### **Recommendations**

An improved cook stove project alters the social fabric of a community on many levels. An awareness of this shift is important to be aware of any large-scale community intervention. This project had an incredibly high usage range—at the end of the month, including those who made modifications to the stove, it was 100%. Involvement of the communities from the start is likely the factor that contributed most to this high usage rate. Community members with the help of their community health workers were able to direct the environmental health intervention that would best suit their desires and situation. Even though all chose the stove, there is a different mindset when those who receive the stove believed it to be a need rather than simply told it was a problem.

The CHWs were then able to troubleshoot and quickly assess the project as the months went on and continue to do so. The importance of this cannot be stressed enough. The balance of service, research, and commitment is integral to the work of those at PIH and ETESC. With an eager generation of CHWs and community wide involvement the project has seen an initial, dramatic and potentially sustainable change. Future research and projects must avoid installation without empowerment as much as possible. An empowered work force leads to an empowered community, which in this case leads to an improved cook stove project that will have a lasting impact for years to come.

### References

- Agarwal, B. (1986). *Cold hearths and barren slopes--the woodfuel crisis in the third world*.  
Riverdale, MD, USA: The Riverdale Company.
- Ayala, G., Vaz, L., Earp, J., Elder, J., & Cherrington, A. (2010). Outcome effectiveness of the lay health advisor model among Latinos in the United States: an examination by role. *Health Education Research*, 25(5), 815-840.
- Brownstein, J., Bone, L., Dennison, C., Hill, M., Kim, M., & Levine, D. (2005). Community health workers as interventionists in the prevention and control of heart disease and stroke. *American Journal of Preventive Medicine*, 29(5 Suppl 1), 128-133.
- Clark, M., Peel, J., Burch, J., Nelson, T., Robinson, M., Conway, S., et al. (2009). Impact of improved cookstoves on indoor air pollution and adverse health effects among Honduran women. *International Journal of Environmental Health Research*, 19(5), 357-368.
- Dasgupta, P., & Ray, D. (1986). Inequality as a determinant of malnutrition and unemployment: Theory. *Economic Journal*, 96, 1011-1034.
- Dasgupta, P., & Ray, D. (1987). Inequality as a determinant of malnutrition and unemployment: Policy. *The Economic Journal*, 97, 177-188.
- Dasgupta, P., & Ray, D. (1991). Adapting to undernourishment: The biological evidence and its implications. *The political economy of hunger: Volume 1: Entitlement and well-being*.  
Oxford University Press. doi:<http://dx.doi.org/10.1093/acprof:oso/9780198286356.003.0007>
- Díaz, E., Bruce, N., Pope, D., Lie, R., Díaz, A., Arana, B., et al. (2007). Lung function and symptoms among indigenous Mayan women exposed to high levels of indoor air pollution. *International Journal of Tuberculosis and Lung Disease*, 11(12), 1372-1379.

- Diaz, E., Bruce, N., Pope, D., Diaz, A., Smith, K., & Smith-Siversten, T. (2008). Self-rated Health among Mayan women participating in a randomised intervention trial reducing indoor air pollution in Guatemala. *BMC International Health and Human Rights*, 8(7).
- Deitrick, L., Paxton, H., Rivera, A., Gertner, E., Biery, N., Letcher, A., Lahoz, L., Maldonado, E., & Salas-Lopez, D. (2010). *Qualitative Health Research*, 20(3), 386-399.
- Duflo, E., Greenstone, M., & Hanna, R. (2008). Indoor air pollution, health and economic well-being. *S.A.P.I.E.N.S. [Online]*, doi:<http://sapiens.revues.org/130>
- Dutta, S. (1997). Role of women in rural energy programmes: Issues, problems and opportunities. *ENERGIA News*, 1(4).
- Fullerton, D., Bruce, N., & Gordon, S. (2008). Indoor air pollution from biomass fuel smoke is a major health concern in the developing world. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 102(9), 843-851.
- Global Alliance for Clean Cookstoves (2012). Issue Overview. Retrieved January 15, 2012. <http://cleancookstoves.org/overview/>
- Guest, G., MacQueen, K., & Namey, E. (2012). *Applied Thematic Analysis*. Los Angeles, CA: SAGE Publications.
- Harris, S., Weeks, J., Chen, J., & Layde, P. (2011). Health effects of an efficient vented stove in the highlands of Guatemala. *Global Public Health*, 6(4), 421-432.
- Helps International. (2004). *The ONIL stove*. Retrieved January 10, 2012, from <http://www.helpsintl.org/programs/stove.php>
- Instituto Nacional de Estadística. (2008). *Estimaciones de la poblacion total por municipio*. Retrieved January 10, 2012, from [www.ine.gob.gt/np/poblacion/Municipios2008'2020.xls](http://www.ine.gob.gt/np/poblacion/Municipios2008'2020.xls)

- International Energy Agency (2006). World Energy Outlook 2006 Edition. Accessed January 15, 2012 from <http://www.iea.org/weo/2006.asp>
- Masera, O., Edwards, R., Arnez, C., Berrueta, V., Johnson, M., Bracho, L., Riojas-Rodriguez, H., & Smith, K. (2007). Impact of Patsari improved cookstoves on indoor air quality in Michoacan, Mexico. *Energy for Sustainable Development*, 11(2), 45-56.
- Mavalankar, D., Trivedi, C., & Gray, R. (1991). Levels and risk factors for perinatal mortality in Ahmedabad, India. *Bulletin of the World Health Organization*, 69(4), 435-442.
- Mishra, V., Retherford, R., & Smith, K. (1999). Biomass cooking fuels and prevalence of tuberculosis in India. *International Journal of Infectious Disease*, 3(3), 119-129.
- Orozco-Levi, M., Garcia-Aymerich, J., Villar, J., & Ramirez-Sarmiento, A. (2006). Wood smoke exposure and risk of chronic obstructive pulmonary disease. *European Respiratory Journal*, 27(3), 542-546.
- Partners In Health. (2011). *ETESC/Guatemala*. Retrieved January 10, 2012, from <http://www.pih.org/pages/guatemala>
- Patton, M. (2002). *Qualitative Research and Evaluation Methods*. 3<sup>rd</sup> edition, Thousand Oaks: Sage Publications.
- Pokhrel, A., Smith, K., Khalakdina, A., Deuja, A., & Bates, M. (2005). Case-control study of indoor cooking smoke exposure and cataract in Nepal and India. *International Journal of Epidemiology*, 34(3), 702-708.
- Rabin, B., Brownson, R., Haire-Joshu, D, Kreuter, M., & Weaver, N. (2008). A Glossary for Dissemination and Implementation Research in Health. *Journal of Public Health Management Practice*, 14(2), 117-123.

- Ramirez-Venegas, A., Sansores, R., Perez-Padilla, R., Regalado, J., Velazquez, A., & Sanchez, C. (2006). Survival of patients with chronic obstructive pulmonary disease due to biomass smoke and tobacco. *American Journal of Respiratory and Critical Care Medicine*, 4(173), 393-397.
- Ruiz-Mercado, I., Masera, O., & Zamora, H. (2011). Adoption and sustained use of improved cookstoves. *Energy Policy*, 39, 7557-7566.
- Sinton, E., Smith, K., Peabody, J., Liu, Y., Edwards, R., Milet, M., et al. (2004). Improved household stoves in china: An assessment of the national improved stove program (NISP). *Main Project Report for the Shell Foundation, London, UK*,
- Smith, K., Mehta, S., & Feuz, M. (2004). Indoor smoke from household solid fuels. In M. Ezzati, A. Rodgers, A. Lopez & C. Murray (Eds.), *Comparative quantification of health risks: Global and regional burden of disease due to selected major risk factors*. Geneva: World Health Organization.
- Smith, K., McCracken, J., Weber, M., Hubbard, A., Jenny, A., Thompson, L., Balmes, J., Diaz, A., Arana, B., & Bruce, N. (2011). Effect of reduction in household air pollution on childhood pneumonia in Guatemala (REPSIRE): a randomized controlled trial. *The Lancet*, 378(9804), 1717-1726.
- Swider, S. (2002). Outcome effectiveness of community health workers: an integrative literature review. *Public Health Nursing*, 19(1), 11-20.
- Tinker, I. (1987). The real rural energy crisis: Women's time. *Energy Journal*, 3, 125-146.
- Troncoso, K., Castillo, A., Masera, O., & Merino, L. (2007). Social perceptions about a technological innovation for fuelwood cooking: Case study in rural Mexico. *Energy Policy*, 35(5), 2799-2810.



- Trotter, R., Needle, R., Goosby, E., Bates, C., & Singer, M. (2001). A Methodological Model for Rapid Assessment, Response, and Evaluation: The RARE Program in Public Health. *Field Methods*, 13(2), 137-159.
- Wafula, E., Kinyanjui, M., Nyabola, L., & Tenambergen, E. (2000). Effect of improved stoves on prevalence of acute respiratory infection and conjunctivitis among children and women in a rural community in Kenya. *East African Medical Journal*, 77(1), 37-41.
- World Bank. (2011). Household cookstoves, environment, health, and climate change: A new look at an old problem.
- World Bank. (2011). World Development Indicators. Last updated Dec 15, 2011.
- World Health Organization. (2006). *Indoor air pollution and lower respiratory tract infections in children*. Paris: International Society of Environmental Epidemiology.
- World Health Organization. (2011). *Indoor air pollution and health*. Retrieved January 2012, 2012, from <http://www.who.int/mediacentre/factsheets/fs292/en/>
- World Health Organization (2012). *Household Air Pollution*. Retrieved January 13, 2012, from [http://www.who.int/gho/phe/indoor\\_air\\_pollution/en/index.html](http://www.who.int/gho/phe/indoor_air_pollution/en/index.html)
- Zhang, J., & Smith, K. (1996). Hydrocarbon emissions and health risks from cookstoves in developing countries. *Journal of Exposure Analysis and Environmental Epidemiology*, 6(2), 147-161.
- Zhang, J., & Smith, K. (2002). Indoor air pollution: a global health concern. *British Medical Bulletin*, 68, 209-225.

## Appendices

### Appendix A: Public Health human subject training certificate

**Charles Garven (Member ID: 2334009)**

**CITI** Collaborative Institutional Training Initiative

[Resources](#) [Main Menu](#) [Select Language](#) [Logoff](#)

---

**Main Menu**

- This is the email address we have for you: [garven.2@wright.edu](#). If this is not correct, click [here](#) to edit your email address and other account information including your security question and answer.
- You are affiliated with 1 participating institution(s) on the CITI website. You will have at least one **grade book** per institution to track your progress in meeting the institution's coursework requirements (see below).

[Affiliate with another institution](#) [View Wright State University instructions page](#) | [Change login information](#) | [Click here to Apply for CME/CEU Credits](#)

---

**Wright State University** [View Wright State University instructions page](#)

You have enrolled for the following courses:

<a href="#">My Courses</a>	Status	Completion Reports	CME/CEU Credits	Voluntary Satisfaction Survey
Health Information Privacy and	Passed	<a href="#">Print</a>	<a href="#">CME/CEU Credits</a>	<a href="#">Please Complete</a>

Security (HIPS) for Clinical Investigators, Basic Course	07/12/11			<a href="#">Now</a>
Health Information Privacy and Security (HIPS) for Students and instructors, Basic Course	Passed	<a href="#">Print</a>	<a href="#">CME/CEU Credits</a>	<a href="#">Please Complete Now</a>
Social/Behavioral Investigator, Basic Course	Passed	<a href="#">Print</a>	<a href="#">CME/CEU Credits</a>	<a href="#">Please Complete Now</a>
	07/15/11			

**7 Add a course or update your learner groups for Wright State University**

**Wright State University Learner Utilities**


- 7 [Optional Modules](#) (completion is completely voluntary and will not count toward a completed course)
- 7 [Update my profile information for Wright State University](#)
- 7 [See a list of all modules that you have completed \(goes back to approximately May 2005\)](#)
- 7 [Click here to see your previously completed coursework for Wright State University](#)
- 7 [Remove my affiliation from Wright State University](#)

**Appendix B: IRB approval letter**

Office of Research and Sponsored Programs  
201J University Hall  
3640 Col. Glenn Hwy.  
Dayton, OH 45435-0001  
(937) 775-2425  
(937) 775-3781 (FAX)  
e-mail: [rsp@wright.edu](mailto:rsp@wright.edu)

**DATE:** September 08, 2011

**TO:** Charles Garven, PI, Student  
Global Health Systems, Management and Policy  
Cristina Redko, Ph.D., Faculty Advisor

**FROM:** B. Laurel Elder, Ph.D., Chair   
WSU Institutional Review Board

**SUBJECT:** SC# 4561

*'Monitoring and Evaluation of Environmental Health Interventions in Communities of Jacaltenango, Huehuetenango, Guatemala'*

This memo is to verify the receipt and acceptance of your response to the conditions placed on the above referenced human subjects protocol/amendment.

These conditions were lifted on: 09/08/2011

This study/amendment now has full approval and you are free to begin the research project. If this is a VA proposal, you must still receive a letter of approval from the Research and Development Committee prior to beginning the research project. This implies the following:

1. That this approval is for one year from the approval date shown on the Action Form and if it extends beyond this period a request for an extension is required. (Also see expiration date on the Action Form)
2. That a progress report must be submitted before an extension of the approved one-year period can be granted.
3. That any change in the protocol must be approved by the IRB; otherwise approval is terminated.

If you have any questions concerning the condition(s), please contact Jodi Blacklidge at 775-3974.

Thank you!

Enclosure

## RESEARCH INVOLVING HUMAN SUBJECTS

SC# 4561

ACTION OF THE WRIGHT STATE

Continuing Review

UNIVERSITY

EXPEDITED REVIEW

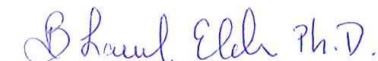
Assurance Number: FWA00002427

Title: *'Monitoring and Evaluation of Environmental Health Interventions in Communities of Jacaltenango, Huehuetenango, Guatemala'*

Principal Investigator: Charles Garven, PI, Student  
Global Health Systems, Management and Policy  
Cristina Redko, Ph.D., Faculty Advisor

The Institutional Review has approved the continued use of human subjects on this project, with conditions previously noted. The conditions have been removed. If the protocol and/or other documents used in the project have been amended within the past five years, you will be requested to submit a new protocol incorporating these amendments.

REMINDER: Federal regulations require prompt reporting to the IRB of any changes in research activity [changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), except where necessary to eliminate apparent immediate hazards to subjects] and prompt reporting of any serious or on-going problems, including unanticipated adverse reactions to biologicals, drugs, radioisotope labeled drugs or medical devices.



Signed

Chair, WSU-IRB

Date: August 12, 2011

IRB Meeting Date: September 19, 2011

**This approval is effective only through: August 11, 2012**

To continue the activities approved under this protocol you should receive the appropriate form(s) from Research and Sponsored Programs (RSP) two to three months prior to the required due date. If you do not receive this notification, please contact RSP at 775-2425.



**Environmental Health - Community Consent Form**

As a community group, you have chosen to receive [intervention, either stoves, water tanks or water filters]. We would like to collect information about how the [intervention] is working.

This means that [study staff name] would make several home visits to a group of houses to ask questions and take measurements both before the [intervention] is given to you, and again after. This information can then be compared to see if there is a positive change. There will also be the opportunity to report any problems that you are experiencing with the [intervention]. It will take up to 8 months to complete the before and after visits.

*If stoves:* A picture of your old stove will be taken. You will be asked to wear a small tube that tests air quality. You will be asked questions about how you get wood, and about your health. How much wood you use for making a meal will be measured with a weight scale.

*If water tanks:* Measurements of your old water vessels will be taken. You'll be asked about how you collect water, about how you use water, and about your health.

*If water filters:* You will be asked about how you currently get drinking water, and about how much time or money this requires. You will be asked about your health. If you boil water, the amount of wood you use will be measured with a weight scale. A sample of the water in your house will be taken and analyzed for bacteria.

If during the visits you tell us that you are sick, we will encourage you to see a health care provider who is locally available. If you continue to be sick, we have project nurses and doctors whom you can visit. Please feel free to speak with us about this option.

We are collecting this information because it will help us understand whether or not the [intervention] helped the participants. This will help us improve the project for future participants. Once the study is completed and we have processed the results, we will present these comparison results back to you in a group meeting where we can discuss what they mean.

Not everyone will need to participate in this study. Only a randomly selected group will be asked to participate. We hope to include over half of the community group in the study. It is not required to participate in the study. Even if you do choose to participate, you may decide to stop the study at any time without any negative consequences. Each household that chooses to participate in the study will be assigned a code. This way, all answers will be anonymous, which means that only you and the study staff know your answers.

Partners In Health, a Non-Governmental Organization based in the United States who works with ETESC, a Civil Association in Guatemala, received a donation from Green Mountain Coffee Roasters for this project. The donation also has money set aside to do this study.

As you already know, you are receiving the [intervention] free of charge. If you participate in the study, you will not be paid. However, if you are asked to participate in the study but decide not to, you may still get the [intervention].

☐ We as a community agree to participate in the study.

☐ We as a community group prefer not to participate in the study.

WSU-IRB  
APPROVED 9-8-11  
GOOD TILL 8-11-12

**Informed Consent for Participation in the Focus Group**

We are holding a focus group to learn your opinions about [intervention] so that we can improve our projects over time. In a focus group, we will ask you questions about your opinions and experiences. We are asking you to participate because you have received a [intervention]. Everyone who received a [intervention] is invited to participate in these focus groups because we value your opinions and experiences, and want to learn from you.

It is not required to participate. If you choose to participate, our conversation will take about one to two hours. All your answers in the group will be compiled and written down, but your name will not be recorded, therefore your statements will be confidential. You may decide to stop participating in the focus group at any time without any negative consequences. This means that you may leave at any time and still be able to use your [intervention] and still be eligible for another [intervention] in the future.

A benefit to participating is providing information that may help us all understand how the [intervention] changed your life. A risk is that you may feel stress or discomfort answering questions. We will encourage you to express your thoughts, but you are not required to answer any questions if you don't want to.

As you already know, you have received the [intervention] free of charge. If you participate in the focus group, you will not be paid.

Would you like to participate?

- ☐ Yes, I would like to participate in the focus group
- ☐ No, I prefer not to participate in the focus group.

WSU-IRB  
APPROVED 9-8-11  
GOOD THRU 8-11-12

**Consentimiento individual**

Como un grupo comunitario, ustedes han decidido realizar un proyecto de estufas mejoradas. Además han decidido participar en una encuesta midiendo si las estufas funcionan bien para ustedes.

Su hogar ha sido seleccionado al azar para ser uno de los participantes del estudio. Ahora les pedimos individualmente si desean participar en la encuesta.

No tiene que participar. Si decide participar, la promotor/a haría varias visitas a su domicilio para hacer preguntas y tomar medidas tanto antes de instalar la estufa y después. Más tarde se comparara esta información para ver si hay un cambio positivo. También usted tendrá la oportunidad de informar a la promotor/a de cualquier problema que experimenta con las estufas. Tardará hasta 8 meses para completar las visitas de antes y después.

Un beneficio de participar es proporcionar información que nos ayudará a comprender a cómo la estufa cambia su calidad de vida. Es un riesgo puede sentir estrés o molestia de responder a preguntas sobre su vida cotidiana o recibir las visitas de la promotora en su hogar.

Puede tomarse una foto de su vieja estufa. Se le haran preguntas acerca de cómo obtiene leña y acerca de su salud. Se medirá el peso de la cantidad de leña que se utiliza dentro de 24 horas. Se le pedirá llevar un pequeño tubo en la ropa que prueba la calidad del aire para unos 24 horas en dos ocasiones. Este tubo mide un producto químico en el humo que pensamos disminuirá con la nueva estufa. El tubo está hecho de vidrio, así que debe poner atención en ello para asegurar que no se quiebre (por ejemplo, le proporcionaremos hule para que el tubo este protegido).

¿Le gustaría participar en la encuesta?

\_\_\_ Sí, me gustaría participar en la encuesta.

\_\_\_ No, prefiero no participar en la encuesta.

WSU-IRB  
APPROVED 9-8-11  
GOOD THRU 8-11-12



Permission letter for the community group

To be read in a loud voice for the promotion of environmental health

As a group, you have decided to do a project of (stoves/filters/water containment). ETESC proposes that you participate in a survey to find out the effectiveness of this project.

A survey means that I visit houses and I ask questions to the people of this group before the project and after the project. So that it is able to compare the situation before and after the project to see if there are positive changes. Each house that participates is going to be assigned with a number, and not with names. In that way, the answers will be anonymous.

If you decide to participate, we let you know the results. The intention of the survey is that this information serves you to reflect about the project and to make decisions about the year to come.

This activity of survey is supported with funds from the same group that supports the project in general. It is a fair trade coffee business called Montana Verde (Green Mountain Coffee Roaster. This business returns a portion of its earnings to the people in the form of scholarships each year

We hope to include a third part of the group or more in the survey. Each family that participates will receive a visit each week for some weeks before the project and some weeks after. (It is not obligatory to participate in this activity). If they decide to not participate, they are still able to be in the project and you will not see negative consequences. If they decide to participate and at any moment do not agree with the questions, they are able to stop.

\_\_\_ As a community group, we agree to participate in the survey

\_\_\_ As a community group, we prefer not to participate in the survey

WSU-IRB

APPROVED 9-8-11

GOOD THRU 8-11-12

### Individual consent

As a community group, you have decided to do a stove project. Also, you have decided to participate in a survey measuring if the stoves function well for you.

Your home has been selected at random to be one of the participants of the study. Now we ask you individually if you wish to participate in the survey.

You do not have to participate. If you decide to participate, the promoter will make various visits to your home to ask questions and to measure both before and after installation of the stove. Later the information is compared to see if there is a positive change. Also you will have the opportunity to inform the promoter of whatever problem that you experience with the stoves. It will take 8 months to complete the before and after visits.

A benefit of participating is to provide information that will help us to understand how the stove changes your quality of life. It is a risk that you are able to feel stress or bothered to respond to questions about your everyday life or to receive visits from the promoter at your home.

We will take a photo of your old stove. You will be asked questions about how you obtain firewood and about your health. The weight of the quantity of your firewood that you use in 24 hours will be measured. You will be asked to wear a small tube into the clothes that tests the air quality for 24 hours on two occasions. This tube measures a chemical product in the smoke that we think will decrease with the new stove. This tube is made of glass, so you should pay attention to assure that it does not break (for example, we will provide rubber so that the tube is protected.)

Would you like to participate in the survey?

☐ Yes, I would like to participate in the survey.

☐ No, I prefer not to participate in the survey.

WSU-IRB

APPROVED 9-8-11  
GOOD TILL 8-11-12

**Appendix C: Statement of support from Dr Dan Palazuelos**

July 31, 2011

**To The Center for Global Health Systems, Management, and Policy Travel and Research  
Scholarship Committee Members:**

**Concerning Charles Garven:**

I write this as a sponsorship letter in regards to MD/MPH candidate Charles (Chad) Garven. He is a Wright State University medical student known to our organization Partners in Health, based in Boston, Massachusetts. Specifically, Chad will be travelling to our partner project site in Guatemala for the month of October, 2011.

Equipo Técnico de Educación en Salud Comunitaria (ETESC, Technical Team for Education in Community Health) was founded by refugees of the Guatemalan civil war who returned to help rebuild their country. Today it has evolved into a community nonprofit that seeks to revitalize and repair the social fabric in the rural communities of Huehuetenango, Guatemala, through holistic development. The organization provides health care, legal accompaniment, and education to each of the communities with which it works.

ETESC teaches communities about environmental issues and undertakes projects of their choosing to address them. ETESC is working with five indigenous communities to improve home air and water quality in order to protect the environment.

I am pleased to guarantee Chad a volunteer position working with us and support and mentorship to give him a safe and supervised environment working with an experienced Guatemalan field team to ensure the feasibility of his exciting project. His work will be directly involving interviewing community members who have received interventions regarding improved wood-burning stoves, water filters, and water tanks.

Please contact me if any further information would be helpful. My email is [dpalazuelos@gmail.com](mailto:dpalazuelos@gmail.com).

Sincerely,

Daniel Palazuelos, MD, MPH  
Clinical Director of Partners in Health supported project in Guatemala  
Associate Physician at Brigham and Women's Hospital  
Instructor of Medicine at Harvard Medical School

**Appendix D: Public Health Competencies Met**

<b>Specific Competencies</b>
<b>Domain #1: Analytic Assessment Skill</b>
Defines a problems
Determines appropriate uses and limitations of both quantitative and qualitative data
Selects and defines variables relevant to defined public health problems
Identifies relevant and appropriate data and information sources
Evaluates the integrity and comparability of data and identifies gaps in data sources
Applies ethical principles to the collection, maintenance, use, and dissemination of data and information
Partners with communities to attach meaning to collected quantitative and qualitative data
Makes relevant inferences from quantitative and qualitative data
Obtains and interprets information regarding risks and benefits to the community
Applies data collection processes, information technology applications, and computer systems storage/retrieval strategies
Recognizes how the data illuminates ethical, political, scientific, economic, and overall public health issues
<b>Domain #2: Policy Development/Program Planning Skills</b>
Collects, summarizes, and interprets information relevant to an issue
Utilizes current techniques in decision analysis and health planning
Decides on the appropriate course of action
Develops a plan to implement policy, including goals, outcome and process objectives, and implementation steps
Develops mechanisms to monitor and evaluate programs for their effectiveness and quality
<b>Domain #3: Communication Skills</b>
Communicates effectively both in writing and orally, or in other ways
Solicits input from individuals and organizations
Advocates for public health programs and resources
Leads and participates in groups to address specific issues
Uses the media, advanced technologies, and community networks to communicate information
Effectively presents accurate demographic, statistical, programmatic, and scientific information for professional and lay audiences
<b>Attitudes</b>
Listens to others in an unbiased manner, respects points of view of others, and promotes the expression of diverse opinions and perspectives
<b>Domain #4: Cultural Competency Skills</b>
Utilizes appropriate methods for interacting sensitively, effectively, and professionally with persons from diverse cultural, socioeconomic, educational, racial, ethnic and professional backgrounds, and persons of all ages and lifestyle preferences
Identifies the role of cultural, social, and behavioral factors in determining the delivery of public health services
Develops and adapts approaches to problems that take into account cultural differences
<b>Attitudes</b>
Understands the dynamic forces contributing to cultural diversity
Understands the importance of a diverse public health workforce

Specific Competencies	
Domain #5: Community Dimensions of Practice Skills	
Establishes and maintains linkages with key stakeholders	
Utilizes leadership, team building, negotiation, and conflict resolution skills to build community partnerships	
Collaborates with community partners to promote the health of the population	
Identifies how public and private organizations operate within a community	
Accomplishes effective community engagements	
Identifies community assets and available resources	
Develops, implements, and evaluates a community public health assessment	
Describes the role of government in the delivery of community health services	
Domain #6: Basic Public Health Sciences Skills	
Identifies the individual's and organization's responsibilities within the context of the Essential Public Health Services and core functions	
Defines, assesses, and understands the health status of populations, determinants of health and illness, factors contributing to health promotion and disease prevention, and factors influencing the use of health services	
Identifies and applies basic research methods used in public health	
Applies the basic public health sciences including behavioral and social sciences, biostatistics, epidemiology, environmental public health, and prevention of chronic and infectious diseases and injuries	
Identifies and retrieves current relevant scientific evidence	
Identifies the limitations of research and the importance of observations and interrelationships	
Attitudes	
Develops a lifelong commitment to rigorous critical thinking	
Domain #7: Financial Planning and Management Skills	
Manages programs within budget constraints	
Monitors program performance	
Applies basic human relations skills to the management of organizations, motivation of personnel, and resolution of conflicts	
Domain #8: Leadership and Systems Thinking Skills	
Creates a culture of ethical standards within organizations and communities	
Helps create key values and shared vision and uses these principles to guide action	
Identifies internal and external issues that may impact delivery of essential public health services (i.e. strategic planning)	
Facilitates collaboration with internal and external groups to ensure participation of key stakeholders	
Promotes team and organizational learning	
Contributes to development, implementation, and monitoring of organizational performance standards	